Research Note

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SOIL WATER DISTRIBUTION ON A CONTOUR-TRENCHED AREA

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ABSTRACT

Six years of soil water measurements on and adjacent to a contour-trenched area revealed that some redistribution of soil water occurred following trenching. However, trenching did not alter the soil water conditions sufficiently to significantly change water yields from the catchment. A reduction in water use from trench bottoms was offset by an increased loss from the cut-bank and trench fills. No change in soil water was apparent between trenches.

Watersheds along the crest of the Wasatch Mountain Range in Utah were so severely overgrazed, burned, and deforested around the turn of the century that accelerated erosion resulted in frequent mud-rock floods during high-intensity summer rainstorms. Rehabilitation practices, initiated in the early 1930's, included contour trenching (Bailey 1947). Trenching is still used where watershed conditions dictate that trenching is necessary to stabilize the soil until vegetation can be reestablished. During the past 10 years the practice has been questioned by water users who fear that it could eventually reduce water yields. In 1964, studies were started to determine what effects trenching might have on the timing and the volume of water yields other than the recognized reduction of peak flows from summer storms. Associated with this work were soil water measurements which are reported here.

In this paper, the term "soil water" is used in place of the more familiar term "soil moisture" to stress the fact that the neutron probe used to measure water in the soil makes no distinction as to the water's state or type of bonding (retention or detention) that may be related to its presence.

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METHODS

The Halfway Creek drainage, Davis County Experimental Watershed, Farmington, Utah, was contour trenched during the summer of 1964. A year later, access tubes to facilitate soil water measurements were installed on seven plots (fig. 1). Four tubes were placed in each plot. Four plots were on the trenched area and three were on an adjacent untrenched area, making a total of 28 sample points. Tubes on each of the trenched area plots were located so that one tube was midway between trenches, one was 2 feet above the trench cut bank, one was in the bottom of the trench, and a fourth was on top of the trench fill (fig. 2).

Soil water measurements were made in the spring and mid-September of each year from 1966 through 1971. Using the neutron probe technique, measurements were made to a depth of 6 feet at 1-foot intervals. Spring readings were made as soon as possible after snowmelt, which varied from early May to mid-June. Precipitation, snow distribution, vegetation, and streamflow measurements were also taken during this study.

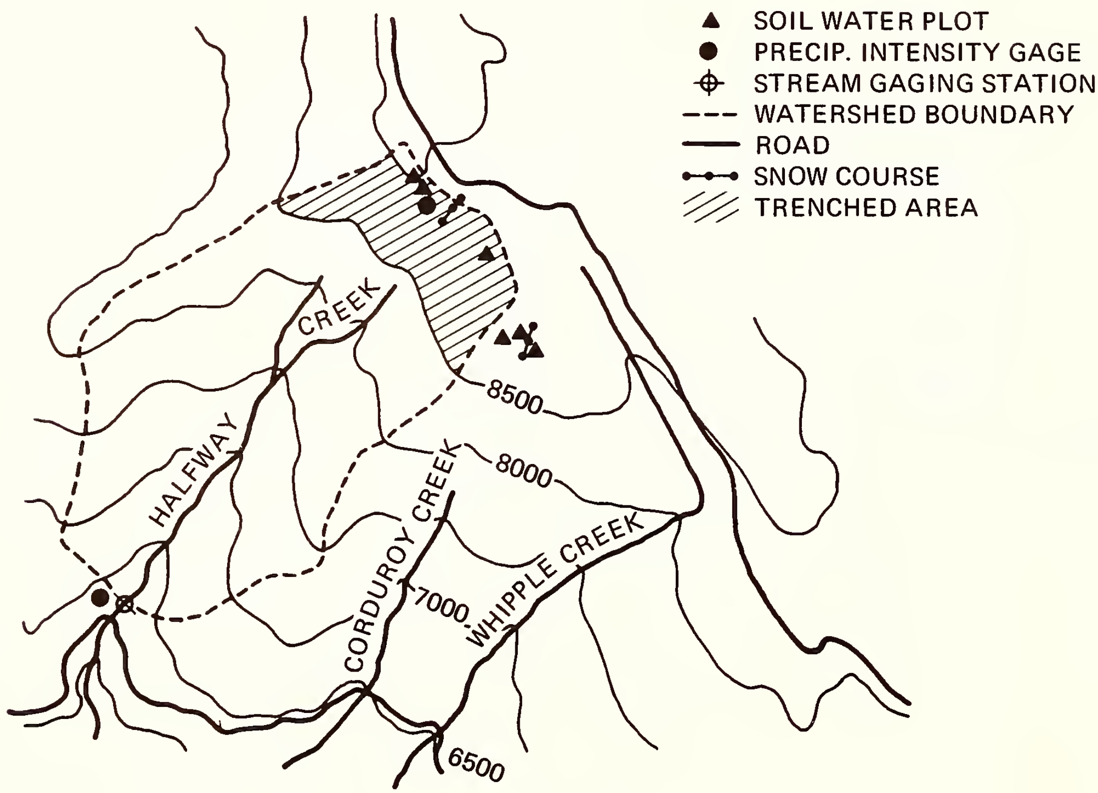


Figure 1.--Topographic map of Halfway Creek and adjacent drainages showing the location of contour trenches, soil water-access tubing plots and other instrumentation.

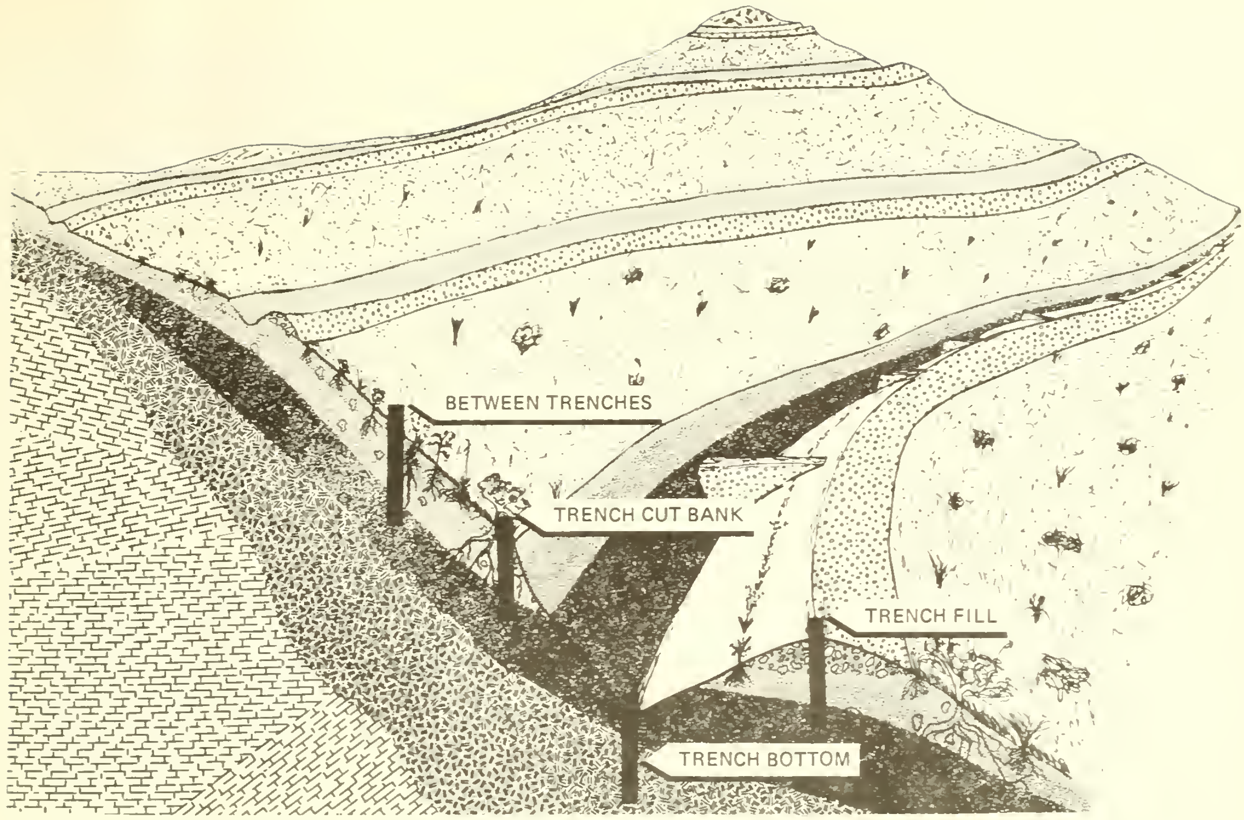


Figure 2.--Arrangement of soil water-access tubing on one of four plots in the trenched area of the Halfway Creek drainage.

RESULTS

Contour trenching disturbs the immediate trenched area but, in this study, caused no perceptible changes in the area between trenches. Vegetation that existed prior to trenching remained unchanged outside the disturbed area. Vegetation densities between trenches consist of 28 percent shrubs, 27 percent grass, and 4 percent forbs, a total of 59 percent live ground cover. The dominant cover is sagebrush *(Artemisia tridentata* and *A. scopulorum)*. Snow distribution was altered somewhat in the trenches themselves, but the average water content of the snow over the whole trenched area was similar to that on an undisturbed control area (Doty 1969). Also, a comparison of streamflow measurements before and after trenching shows little if any change in water yields attributable to trenching (Doty 1971). These factors indicate that trenching has not had a major effect on the soil water regime of the watershed.

Onsite redistribution of soil water was studied by comparing the measurements from each of the four access tubes with each other and measurements from control plots on the adjacent untrenched area (table 1). Only about 10 inches of water is held in the 6-foot soil profile in the spring prior to any appreciable loss through evapotranspiration. These are rocky, coarse-textured, immature soils of limited water-holding capacity. The high infiltration rates and pervious nature of these soils allow considerable water to move through the soil profile before the growing season begins.

Construction of the trenches apparently altered soil water conditions in trench bottoms. Trench construction displaced 3 to 4 feet of surface soil material. Consequently, soil water-access tubes in trench bottoms were in material at the 4- to 10-foot depths compared to the 0- to 6-foot depths of the intertrench tubes. Material at

Table 1.--*Average quantity of soil water by location in a 6-foot profile*

	Between trenches	Trench cut bank	Trench bottom	Trench fill	Untrenched control
	- - - - - - - - - -	- - - - - - - - - -	*Inches*	- - - - - - - - - -	- - - - - - - - - -
Initial soil water	8.98	9.66	9.57	10.64	9.64
Growing season withdrawal	2.56	3.13	.95	2.66	2.98
Growing season precipitation	4.48	4.48	4.48	4.48	4.48
Total water loss	7.04	7.61	5.43	7.14	7.46

the 4- to 10-foot depths has a lower water-holding capacity. This was offset by gravitational water which was present at the time of spring readings due to shading, less wind, more snow, and later snowmelt. The delayed loss of this gravitational water elevated spring soil water readings to a level similar to most other locations. Further, during the growing season, shading and reduced wind in trench bottoms reduces evaporation losses and the lack of vegetation almost eliminates transpiration losses. These conditions, along with some lateral flow of water into this area, result in less net water loss from a trench bottom than from any other location during the growing season (fig. 3).

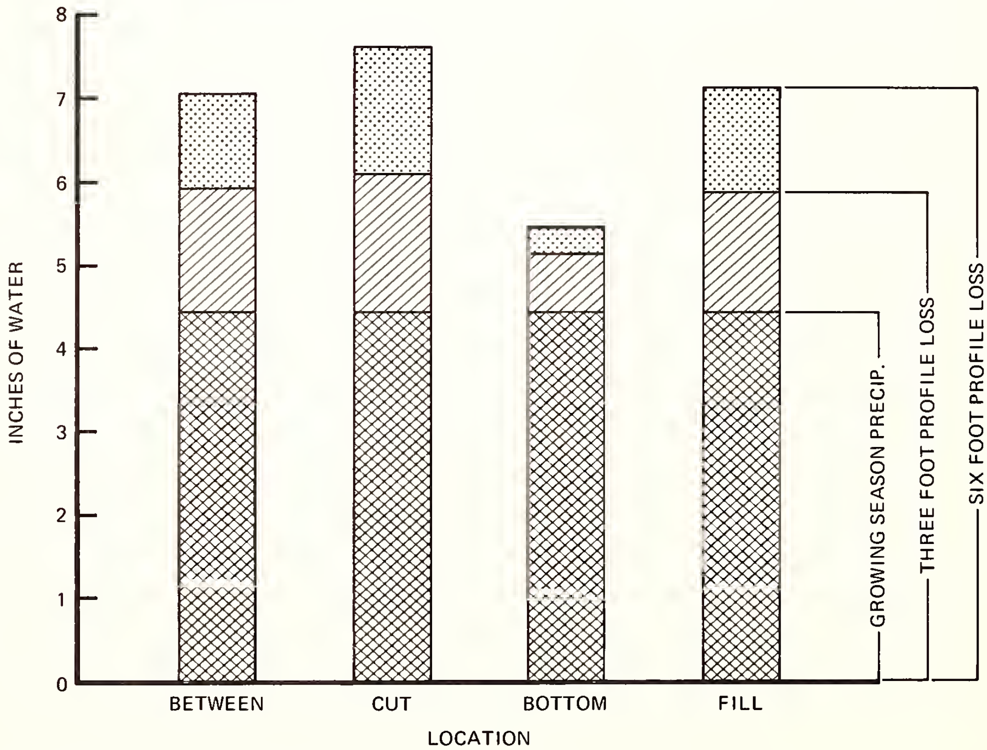
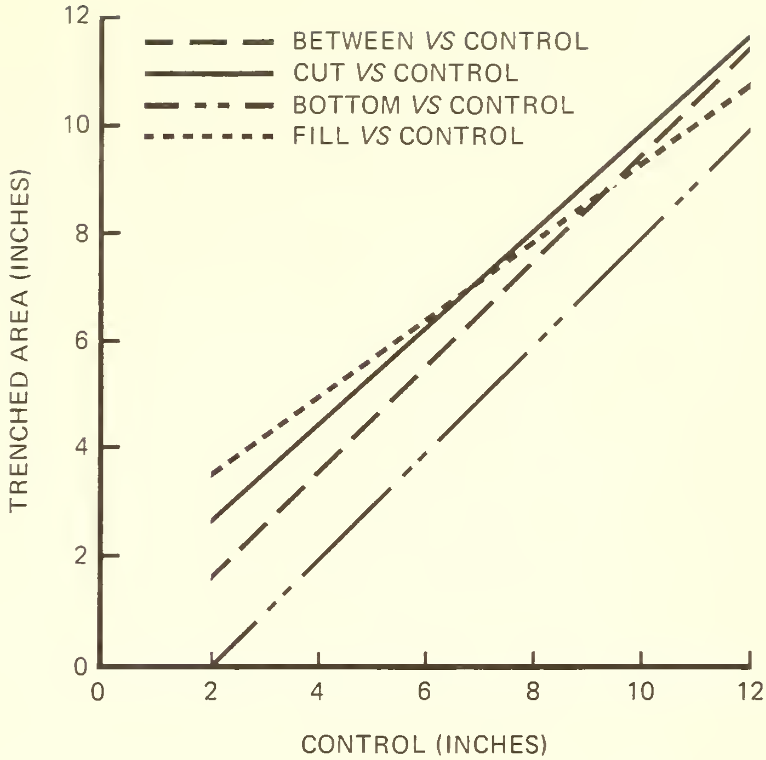


Figure 3.--Average soil water depletion during the growing season under four treatment conditions.

Figure 4.--Correlation of soil water depletion between individual locations and the control.



Trench fills are comprised of soil material from the trenches. This area, greatly disturbed by trench construction, changed each year as the material settled and vegetation became reestablished. More water is present in the trench fills in the spring; however, withdrawal from this material is similar to withdrawal elsewhere. Actually, the trench cut bank shows greater loss than the fills. Evaporation from the exposed cut bank could account for the measured increase. Development of vegetation on the trench fill during the 6 years of measurements has resulted in a trend toward increasing water loss with time, causing the relationship between the fill and the control to deviate from the one-to-one relationship evident on the other three locations (fig. 4). The other three locations measured show no discernible trend over time.

Most of the water withdrawn comes from the upper 3 feet of the soil mantle (fig. 3), as would be expected since most of the vegetation in the area is shallow-rooted. In comparing measurements to 3 and to 6 feet, it was assumed that precipitation during the growing season primarily affected only the upper 3 feet.

During the 6 years of measurement, only one or two storms each year produced a measurable amount of overland flow. Ponding of water in the trenches was not observed except during snowmelt. Soil water measurements made immediately before and after a heavy summer rainstorm showed that the soil had been wetted only to a 1- or 2-foot depth. Consequently, if one assumes that summer precipitation interacts with only the upper 3 feet of soil, then 80 percent of the evapotranspiration loss can be assigned to that layer. In the trench bottoms, nearly 90 percent of all water loss occurred from the upper 3 feet.

CONCLUSIONS

An area of immature and pervious soils, such as that trenched in Halfway Creek, retains relatively small amounts of soil water and readily gives up this water to shallow-rooted vegetation. Trenching results in some redistribution of the soil water, but does not significantly change water loss or resulting streamflow. The cut bank shows some increase in evaporation, whereas trench bottoms, due to a lack of soil and vegetation, show a reduction in loss. Seasonal water loss from the fill increased with time as vegetation occupied the site more completely. Most of the area (that between trenches) changed little if at all in respect to soil water retention or transmission.

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